United States
Department of
Agriculture

Forest
Service

Forest
Products
Laboratory

Dividends From Wood Research

Recent Publications

July–December 1989

Explanation and Instructions

"Dividends From Wood Research" is a semiannual listing of recent publications resulting from wood utilization research at the Forest Products Laboratory (FPL). These publications are produced to encourage and facilitate application of Forest Service research. This issue lists publications received from the printer by the FPL Publications Section between July 1, 1989, and December 31, 1989.

Each publication listed in this brochure is available through at least one of the sources below. For each entry in the brochure, we indicate the primary source for that publication and show you how to obtain a copy:

Available from FPL (indicated by an order number before the title of the publication): Quantities limited. Circle the order number on the blank at the end of the brochure and mail the blank to FPL.

Available through sales outlets (indicated by the name of the outlet and, when available, price information): Major sales outlets are the Superintendent of Documents, the National Technical Information Service (NTIS), and various private publishers. Order directly from the outlet.

Available through libraries: Research publications are available through many public and university libraries in the United States and elsewhere. U.S. Government publications are also available through many Government Depository Libraries. Check with a major library near you to determine availability.

List of Categories

Publications are listed in this brochure within the following general categories:

Anatomy and Identification

IAWA List of Microscopic Features for Hardwood Identification

Wheeler, E.A.; Baas, P.; Gasson, P.
IAWA Committee: 1989. p. 221–332.

Available from Executive Secretary, International Association of Wood Anatomists, Institute of Systematic Botany, Heidelberglaan 2, 3584 CS Utrecht, The Netherlands. $20/copy or $10/copy for 10 or more copies. Include additional $5 for banking and handling. Orders should be prepaid in cash or by check.

This publication lists, defines, and illustrates about 160 wood anatomical features useful for hardwood identification. It defines and discusses 58 other features that are helpful when identifying a hardwood. With its extensive photographic illustrations and explanatory comments, the IAWA List is not only an indispensable tool for all those who wish to build a database for computer-assisted wood identification but also a useful manual for anyone who wants to better understand the microscopic structure of wood.

Biodeterioration and Protection

1. Long-Term Weathering of Finished Aspen Waferboard

Carll, Charles G.; Feist, William C.
Forest Prod. J. 37(4): 27–30; 1989.

This work concerns exterior performance of finished phenolic-bonded aspen waferboard at three geographic locations in the United States. It reports on panel appearance over 6 years of exposure and panel integrity at removal from exposure at 7 years.

2. Field Trials of Copper Naphthenate-Treated Wood

De Groot, R.C.; Link, C.L.; Huffman, J.B.
In: Proceedings of the 84th annual meeting of the American Wood-Preservers' Association: 1988 May 8–11; Minneapolis, MN. Stevensville, MD: American Wood-Preservers' Association; 1988: 186–200.

Copper naphthenate has been accepted as a wood preservative for several decades, but it has not been used extensively in pressure treatments for wood products that will be used in ground contact. This paper addresses concerns about copper-tolerant fungi and evaluates the status of

copper naphthenate-treated stakes in long-term field plots containing materials treated at the USDA Forest Service, Forest Products Laboratory. To date, the location of exposure (Wisconsin compared to Mississippi or Florida) has had a more pronounced effect upon resultant lifetime of stakes than retention of preservative. The efficacy of copper naphthenate in ground contact is also influenced by wood species.

3. Flame-Retardant Treatment of Wood With a Diisocyanate and an Oligomer Phosphonate

Ellis, W.D.; Rowell, R.M.
Wood and Fiber Sci. 21(4): 367–375; 1989.

Objectives of this research were to develop new fire-retardant treatments for wood that are leach resistant and, at the same time, not hygroscopic or corrosive. To accomplish these objectives, an aliphatic diisocyanate and an oligomer phosphonate were mixed in an appropriate solvent, impregnated into the wood, and cured with heat. Reaction of the diisocyanate with the oligomer phosphonate and the wood should enhance leach resistance.

4. Evaluation of Fumigants for Control of Decay in Non-Pressure-Treated Southern Pine Timbers. I. Unwrapped Timbers

Highley, Terry L.; Eslyn, Wallace E.
Holzforschung. 43(4): 225–230; 1989.

This study was initiated primarily to test efficacy of chloropicrin, Vapam, and other selected fumigants in eradicating decay fungi inoculated in horizontally oriented southern pine timbers. Other objectives of the study were to determine the extent and rate of penetration of toxic amounts of test fumigants through the timbers and the longevity of fungitoxic concentrations of fumigants in the wood.

5. Evaluation of Fumigants for Control of Decay in Non-Pressure-Treated Southern Pine Timbers. II. Wrapped Timbers

Highley, Terry L.; Eslyn, Wallace E.
Holzforschung. 43(5): 355–357; 1989.

Researchers have been investigating the use of fumigants for remedial control of decay in large, horizontally oriented Douglas-fir and southern pine timbers. In a previous study, less longitudinal movement and persistence of fumigants were found in non-pressure-treated southern pine than in pressure-treated Douglas-fir timbers. Thus, pressure treatment might retard escape of the fumigant from wood. The purpose of this study was to determine if wrapping southern pine timbers to minimize escape of fumigants would enhance movement and persistence of the fumigants.

6. Effect of Brown-Rot Fungi on Cellulose

Highley, T.L.; Kirk, T.K.; Ibach, R.
In: O'Rear, Charles E.; Llewellyn, Gerald C., eds. Biodeterioration research 2—General biodeterioration, degradation, mycotoxins, biotoxins, and wood decay: Proceedings, 2d meeting, Pan American Biodeterioration Society; 1989 July 28–31; Washington, DC. New York: Plenum Press; 1989: 511–525.

To gain further insight into the nature of the biochemical agent involved in the initial depolymerization of cellulose by brown-rot fungi, this paper reports on the (1) ability of several brown-rot fungi to depolymerize chemically pure cellulose under various cultural conditions and (2) physical and chemical properties of brown-rotted cellulose.

7. Controlling Decay in Waterfront Structures

Highley, T.L.; Scheffer, T.
USDA Forest Serv. Res. Pap. FPL–RP–494; 1989. 26 p.

Decay in waterfront structures results in expensive repair or replacement of the damaged components. This manual describes the problems caused by decay and ways to avoid or control decay. The information presented is directed toward personnel who inspect and maintain waterfront structures. The manual describes (1) types of deterioration and underlying causes, (2) construction practices that contribute to decay, (3) decay detection, and (4) decay prevention, including remedial measures for decayed structures.

8. Manganese as a Probe of Fungal Degradation of Wood

Illman, Barbara L.; Meinholtz, Dore C.; Highley, Terry L.
In: O'Rear, Charles E.; Llewellyn, Gerald C., eds. Biodeterioration research 2—General biodeterioration, degradation, mycotoxins, biotoxins, and wood decay: Proceedings, 2d meeting, Pan American Biodeterioration Society; 1989 July 28–31; Washington, DC. New York: Plenum Press; 1989: 485–496.

The objective of this study was to determine if electron spin resonance (ESR) could be used to detect any changes that might occur in the spin orientation of transition metals during wood decay. A model system was developed in which ESR was used to scan for paramagnetic iron and manganese in cottonwood, southern yellow pine, Douglas-fir, white fir, and redwood after inoculation with the brown-rot fungus, *Postia placenta*.

9. Oxygen Free Radical Detection in Wood Colonized by the Brown-Rot Fungus, *Postia Placenta*

Illman, Barbara L.; Meinholtz, Dore C.; Highley, Terry L.
In: O'Rear, Charles E.; Llewellyn, Gerald C., eds. Biodeterioration research 2—General biodeterioration, degradation, mycotoxins, biotoxins, and wood decay: Proceedings, 2d meeting, Pan American Biodeterioration Society; 1989 July 28–31; Washington, DC. New York: Plenum Press; 1989: 497–509.

The major objective of this report was to test a hypothetical scheme for a free radical mechanism involved in brown-rot decomposition of wood. *Postia placenta* (Fr.) M. Lars. et Lomb. was selected as the model fungus for the test. Production of hydrogen peroxide by *P. placenta* has not been well established due to difficulties inherent in culture procedures and in H_2O_2 indicator chromogens.

Chemicals From Wood

10. Hydrogenless Hydrogenation of Resin Acids

Portugal, Ines; Zinkel, Duane F.
Naval Stores Review. 99(4): 13–16; 1989.

Resin acids can be hydrogenated by the transfer of hydrogen from sodium formate in the presence of water and a palladium–carbon catalyst. The primary products are the dihydro derivatives. Incorporation of a polar solvent (methyl *tertiary*-butyl ether) in the solvent increases the reaction rate. This novel hydrogenless hydrogenation will be of value in preparing pure dihydro resin acids for research purposes and may be of potential commercial application because of its simplicity.

Engineering Properties and Design Criteria

Mechanical Properties of CCA-Treated Southern Pine After Post-Treatment Kiln Drying

Barnes, H.M.; Winandy, J.E.
Doc. No. IRG/WP/3543. The International Research Group on Wood Preservation. Working Group III Preservatives and Methods of Treatment: 1989. 11 p.

Available from IRG Secretariat, Drottning Kristinas vag 47C, S–114 28 Stockholm, Sweden. Telephone NATO8–10 1453. Cost 150 Swedish crowns.

This report reviews current research dealing with the effects of waterborne preservative treatment and redrying on the mechanical properties of wood. The American Wood-Preservers' Association (AWPA) has recently initiated an across-the-board redrying temperature limit of 88°C (190°F) for all solid-sawn lumber and timbers. This report discusses recent research results and documents the reasoning behind the AWPA redrying temperature limit.

11. Modeling Vertically Mechanically Laminated Lumber

Bohnhoff, David R.; Cramer, Steven M.; Moody, Russell C.; Cramer, Calvin O.
J. Struct. Eng. 115(10): 2661–2679; 1989.

Research described in this paper formulates a method for modeling the stiffness performance of vertically mechanically laminated wood members; a method that would account for the nonlinear lateral load–slip characteristics of mechanical fasteners and the influence of gap closure at butt joints.

Performance of Lateral Nails and Staples Resistance in Wood Composite Panels During Five Years' Exposure to Weather

Chow, P.; McNatt, D.J. [J.D.]
In: Proceedings, 2d Pacific timber engineering conference; 1989 August 25–31, Auckland, New Zealand. Auckland: Centre for Continuing Education, University of Auckland. Vol. 2; 1989: 201–204.

Available from Poo Chow, Department of Forestry, University of Illinois–Urbana, 110 Mumford Hall, 13010 West Gregory Drive, Urbana, IL 61801. No charge.

This study was started in the late part of 1983 to obtain fastener resistance data on the availability of new structural wood-based sheathing and siding panel products for exterior use. Five types of commercial wood-based panels were tested: waferboard, oriented strandboard, veneered composite, embossed hardboard siding, and the conventional C–D grade Douglas-fir plywood.

12. Predicting Lumber Tensile Stiffness and Strength With Local Grain Angle Measurements and Failure Analysis

Cramer, S.M.; McDonald, K.A.
Wood and Fiber Sci. 21(4): 393–410; 1989.

A mechanistic model is presented for predicting the tensile stiffness and strength of 2 by 4 lumber boards containing a single major face knot. The primary inputs to the model are local grain angle maps for each wide face of a board and estimates of average clear-wood properties. The grain angle maps were obtained through electrical scanning of board surfaces and represented the in-plane orientation of the wood fibers. Out-of-plane dive angles were not considered. The model simulates the failure process that occurs within lumber subject to tension and thereby provides insight to, and understanding of, the failure of wood with defects. The model is devoid of empirical adjustment factors, and it has produced tensile strength predictions that correlate with measured strengths by a correlation coefficient of 0.86 and an average absolute error of 12 percent. It is hoped that insight gained through use of this model will provide a foundation for improvements in lumber grading.

13. Load-Distribution Model for Light-Frame Wood Roof Assemblies

Cramer, Steven M.; Wolfe, Ronald W.
J. Struct. Eng. 115(10): 2603–2615; 1989.

This paper describes a model and a method that may be used to predict the distribution of load among trusses within a roof assembly. Load distribution is defined in this paper as the variation in the vertical load transferred through the truss reaction points to the supporting structure (typically a wall). Reasonable, simplifying assumptions are used so that in applying the assembly model to a wide variety of conditions, it will not require detailed data that are difficult or impossible to obtain. Future application of the model will provide a basis for the development of a design methodology for consideration of the load-distributing behavior of light-frame wood roof assemblies.

Field Monitoring of a Stressed Timber Bridge Over Elk Two-Mile Creek, West Virginia

Dickson, Barry; Gangarao, Dr. Hota V.S.
In: The Conference on Bridges: Proceedings, 6th annual international bridge conference; 1989 June 12–14; Pittsburgh, PA; 1989: 247–252.

Available from Mr. Barry Dickson, West Virginia University, Department of Civil Engineering, Morgantown, WV 26506–6101. No charge.

Interest in timber bridges is rapidly increasing as more engineers become aware of timber capabilities. The monitoring results from this experimental structure will give other designers a background with which to design more efficient and economical timber structures.

14. Two- and Three-Parameter Weibull Goodness-of-Fit Tests

Evans, James W.; Johnson, Richard A.; Green, David W.
USDA Forest Serv. Res. Pap. FPL–RP–493; 1989. 27 p.

This paper presents the results of a study to develop and evaluate goodness-of-fit tests for the two- and three-parameter Weibull distributions. The study was initiated because of discrepancies in published critical values for two-parameter Weibull distribution goodness-of-fit tests, the lack of any critical values for a Shapiro–Wilk-type correlation statistic, and the lack of general three-parameter Weibull distribution goodness-of-fit tests. The results of the study will be used by Forest Products Laboratory scientists to evaluate the goodness-of-fit of Weibull distributions to experimental data. This will allow evaluation of distributional forms that may be used in reliability-based design procedures.

15. Inspection and Evaluation of Wood Structures in North America

Falk, R.H.; Moody, R.C.
In: Proceedings, 2d Pacific timber engineering conference; 1989 August 28–31; Auckland, New Zealand. Auckland: Centre for Continuing Education, University of Auckland. Vol. 2; 1989: 181–183.

This paper overviews the state of the art of the inspection and evaluation of wood structures in North America. Methods and techniques used for the assessment of wood structures and perceived research needs are discussed.

16. Effect of Cyclic Temperature on Duration of Load of Solid Lumber in Bending

Fridley, K.J.; Tang, R.C.
In: Perkins, R.W., ed. Mechanics of cellulosic and polymeric materials: Proceedings, 3d Joint ASCE/ASME Mechanics conference; 1989 July 9–12; San Diego. New York: The American Society of Mechanical Engineers; 1989: 179–184.

A multiphased research program having the overall goal to evaluate and model the effect of the environment on the duration-of-load behavior, also known as creep-rupture, of structural lumber is in progress at Auburn University and is in cooperation with the USDA Forest Service, Forest Products Laboratory. The first phase, which is completed, involves the testing and modeling of the duration-of-load behavior in various constant temperature environments. Little information is available with respect to cyclic temperature. Therefore, the second phase of the research program is designed to investigate and model the duration-of-load behavior of solid lumber under a cyclic temperature and constant humidity environment and is the focus of this paper.

Specific Gravity of Visually Graded Lumber

Green, David W.; Evans, James W.
USDA Forest Serv., Forest Products Lab., Madison, WI: 1989 June. 105 p.

Available from National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161; $21.95 hardcopy; $6.95 microfiche; Order #PB 89–222772/AS.

This document presents tables that summarize specific gravity data obtained on visually graded 2-in. dimension lumber sampled in the U.S. In-Grade Testing Program. Specific gravity estimates are based on ovendry weight and ovendry volume. Species or species groups sampled include Aspen–Cottonwood, Balsam Fir, Douglas Fir–Larch, Douglas Fir (South), Eastern Hemlock, Eastern Spruces (black, red, and white), Eastern White Pine, Engelmann Spruce, Hem–Fir, Idaho White Pine, Jack Pine, Lodgepole Pine, (Minor) Southern Pines, Ponderosa Pine, Red Pine, Sitka Spruce, Southern Pine, Subalpine Fir, Sugar Pine, Tamarack, and Yellow-Poplar. Nonparametric statistics and descriptive statistics for the normal, lognormal, and two- and three-parameter Weibull distributions of specific gravity are provided in the tables. Results of the In-Grade data will be discussed in an intended series of research papers to be published by the Forest Products Laboratory.

17. Structural Wood-Base Panel Performance: Bending Test Methods and Particle Alignment Effects

McNatt, J.D.; Wellwood, R.W.; Bach, L.
In: Proceedings, 2d Pacific timber engineering conference; 1989 August 28–31; Auckland, New Zealand, Auckland: Centre for Continuing Education, University of Auckland. Vol. 1; 1989: 165–169.

The two primary objectives of this comparative research effort were as follows: (1) establish a relationship between bending strength and stiffness determined by the various large-panel tests as well as the small-specimen tests for different types and thicknesses of structural wood-based panels and (2) compare the performance of uniformly aligned and cross-aligned strandboards with that of non-aligned panels made with the same furnish, resin type, and resin content.

18. Analysis of ASTM D 1037 Accelerated-Aging Test

McNatt, J. Dobbin; Link, Carol L.
Forest Prod. J. 39(10): 51–57; 1989.

The two objectives of our study were to (1) evaluate the progressive deterioration of wood-based panel products with each successive exposure cycle in the ASTM D 1037 test and (2) determine how various steps in the ASTM D 1037 six-cycle test contribute to panel deterioration. Results of this study were used to develop a less time-consuming accelerated-aging test, which will be evaluated in a future study.

19. Development of Design Stresses for Glulam Timber in the United States

Moody, R.C.; Falk, R.H.
In: Proceedings, 2d Pacific timber engineering conference; 1989 August 28–31; Auckland, New Zealand. Auckland: Centre for Continuing Education, University of Auckland. Vol. 2; 1989: 309–313.

This paper presents an overview of the current method of assigning design stresses for glulam beams and the research underway that is directed towards characterizing the engineering properties of glulam beams. Research is summarized in the areas of (1) reanalysis of allowable clear wood stresses for design, (2) formulation of equations to represent the volume effect in glulam bending

members, and (3) the use of mathematical models for strength and stiffness predictions.

20. Creep of Structural Lumber

Soltis, L.A.; Nelson, W.; Hillis, J.L.
In: Perkins, R.W., ed. Mechanics of cellulosic and polymeric materials: Proceedings, 3d Joint ASCE/ASME Mechanics conference; 1989 July 9–12; San Diego. New York: The American Society of Mechanical Engineers; 1989: 215–221.

This report presents interim results from a larger test program on the strength and deformation behavior of wood under long-term loading. The objectives are to quantify creep in 2 by 4 structural lumber and to compare creep in lumber subjected to tension and compression under constant load.

21. Bending Strength of Press-Dried Plantation Loblolly Pine

Tang, Yifu; Simpson, William T.
Forest Prod. J. 39(11/12): 57–61; 1989.

The bending strength and stiffness properties of plantation loblolly pine clear wood specimens press dried at 350°F for 90 minutes were compared to those of specimens kiln dried at 240°F for 18 hours.

22. CCA Preservative Treatment and Redrying Effects on the Bending Properties of 2 by 4 Southern Pine

Winandy, J.E.
Forest Prod. J. 39(9): 14–21; 1989.

This study attempts to explain how the distributional characteristics of lumber bending properties are affected by CCA treatments, lumber quality, size, and the presence or absence of pith.

23. Allowable Stresses for the Upside-Down Timber Industry

Wolfe, Ronald W.
In: International conference on wood poles and piles proceedings; 1989 October 25–27; Fort Collins, CO. Fort Collins, CO: Colorado State University/Engineering Data Management, Inc.; 1989: D1–D11.

This paper provides a state-of-the-art summary of the derivation of design stresses for timber piles. It focuses primarily on problems addressed in the development of currently accepted standards and provides commentary on areas of concern that require further research.

24. Structural Performance of Light-Frame Roof Assemblies. I. Truss Assemblies With High Truss Stiffness Variability

Wolfe, R.W.; McCarthy, M.
USDA Forest Serv. Res. Pap. FPL–RP–492; 1989. 41 p.

This is the first report of a three-part series that covers results of a full-scale roof assemblies research program. The focus of this report is the structural performance of truss assemblies comprising trusses with abnormally high stiffness variability and critical joint strength.

Proceedings 47363; In-Grade Testing of Structural Lumber

Available from Forest Products Research Society, 2801 Marshall Court, Madison, WI 53705. Cost $20 each, plus 15 percent domestic postage and handling; 20 percent foreign postage and handling.

The following five articles by FPL authors are found in Proceedings 47363.

Temperature Adjustments for the North American In-Grade Testing Program

Barrett, J. David; Green, David W.; Evans, James W. p. 27–38.

This report summarizes the available research information evaluated by the North American In-Grade Technical Committee and the resulting temperature adjustment relationships used by the Committee to adjust bending strength, modulus of elasticity, and tension strength to a common reference temperature of 73°F. Compression property data were collected in the United States and Canada in a laboratory environment; therefore, no compression strength adjustments were required.

Procedures for Deriving Allowable Properties for Species Groupings

Evans, James W.; Green, David W. p. 68–78.

This paper recommends procedures for deriving allowable properties for species groupings, procedures that remove many of the limitations of the traditional ones. These procedures are also recommended for inclusion in ASTM standards for deriving allowable properties for species groups.

State-of-the-Art Structural Modeling of Light Frame Assemblies and Buildings

Falk, R.H.; Moody, R.C.; Wolfe, R.W. p. 99–103.

This paper discusses analytical modeling in general and briefly reviews the various structural models available for the analysis of wood subassemblies and buildings. Important factors to consider when utilizing these structural models in a reliability-based design methodology are also discussed.

Moisture Content and the Mechanical Properties of Dimension Lumber: Decisions for the Future

Green, David W.; Evans, James W. p. 44–55.

The objectives of this paper are to (1) summarize recent research on the effect of moisture content on the properties of dimension lumber, (2) review the status of current research on the effect of moisture content on lumber properties, (3) discuss implications of new research on the design process, (4) discuss additional research needs, and (5) recommend changes to ASTM standards.

Volume Effect Adjustments for the In-Grade Data

Johnson, Lisa A.; Evans, James W.; Green, David W. p. 56–66.

The analysis of the in-grade data was, and continues to be, a monumental task. The variability of the lumber leads to a diversity of approaches in attempting to simplify the issue of predicting lumber properties. The objective of this report is to develop a methodology for relating strength of one size of lumber to strength of another size. The choice of the best model, made after considerable debate within the In-Grade Testing Program Technical Committee, is discussed. These discussions focused on overall accuracy, simplification, ease of transition, and connection to theoretical explanations.

Fiber and Particle Products

25. Screw-Holding, Internal Bond, and Related Properties of Composite Board Products for Furniture and Cabinet Manufacture: A Survey of the Literature

McNatt, J. Dobbin
In: Hamel, Margaret P., ed. Composite board products for furniture and cabinets—Innovations in manufacture and utilization: Proceedings 47357; 1986 November 11–13; Greensboro, NC. Madison, WI: Forest Products Research Society; 1989: 30–35.

This paper discusses selected properties of particleboard, hardboard, medium-density fiberboard, and plywood related to their use in furniture and cabinet manufacture. Properties covered are screw-holding, internal bond, density profile, and edge appearance.

26. How Moisture Changes Affect Long-Term-Load Performance of Wood-Base Panels in I-Beams and Other Structural Composite Members

McNatt, J.D.; Laufenberg, T.L.
In: Perkins, R.W., ed. Mechanics of cellulosic and polymeric materials: Proceedings, 3d Joint ASCE/ASME Mechanics conference; 1989 July 9–12; San Diego. New York: The American Society of Mechanical Engineers; 1989: 185–191.

This paper summarizes the published literature on the relationship between moisture- and time-dependent properties of panel products and the performance of built-up structural members in which the products are used.

27. Thick Composites Are Technically Feasible With Steam-Injection Pressing

Price, Eddie W.; Geimer, Robert L.
In: Hamel, Margaret P., ed. Composite board products for furniture and cabinets—Innovations in manufacture and utilization: Proceedings 47357; 1986 November 11–13; Greensboro, NC. Madison, WI: Forest Products Research Society; 1989: 65–71.

This study presents conclusions on the technical feasibility of implementing the steam-pressing process in the industrial fabrication of thick flakeboards. Technical feasibility is based on comparable properties of panels made with and without steam-pressing techniques.

28. Technical and Economic Considerations in the Development of OSB Specialties

Spelter, Henry
Crow's Digest—Special Report. 4(2): 4–5; 1989.

This paper discusses (1) what has enabled oriented strandboard (OSB) to become such a force in structural panels in the United States, (2) what factors lie behind penetration of OSB in panel specialties markets, and (3) if OSB can become the same force in these markets as it has shown in commodities.

Fire Safety

29. Kinetic Properties of the Components of Douglas-Fir and the Heat of Combustion of Their Volatile Pyrolysis Products

Parker, William J.; LeVan, Susan L.
Wood and Fiber Sci. 21(3): 289–305.

Specimens of the chemical components of Douglas-fir, which include cellulose, lignin, mannan, and xylan, were pyrolyzed in nitrogen in the temperature range from 290°C and 370°C, which is characteristic of the pyrolysis temperature range of wood in a fire environment. From these data, the effective activation energy, preexponential factor, and the net heat of combustion of the volatiles were calculated as a function of the mass retention fraction of the specimen. These kinetic parameters were used to calculate the mass loss rate of Douglas-fir and to prepare a mixture of the components in a pyrolyzer based on their measured temperature histories.

30. Room Fire Test for Fire Growth Modeling—A Sensitivity Study

Tran, Hao C.; Janssens, Marc L.
Fire Sci. 7: July/Aug. 1989. p. 217–236.

A room test designed according to the ASTM draft standard was used to investigate the effect of various parameters on the contribution of wall and corner fires to compartment fire growth. It was concluded from the data analysis that at least for corner tests, gypsum board should be used for the ceiling and remaining walls as specified in standardized procedures. A burner program of 40 kW for 5 min followed by 160 kW for the next 5 min was the most informative program; it will be used for wall and corner tests in subsequent steps of this ongoing study.

31. Future of Fire-Resistive Coatings in Wood Construction

White, Robert H.
In: Fire retardant coatings and technical research developments for improved fire safety: Proceedings, 1988 FRCA fall conference; 1988 October 2–5; Annapolis, MD. Lancaster, PA: Fire Retardant Chemicals Association; 1989: 185–191.

This paper reviews some of the comments, ideas, and recommendations of the April 29, 1988, workshop on the future of fire-resistive coatings in wood construction, held at the Forest Products Laboratory in Madison, Wisconsin. The approximately 30 attendees represented the wood and coating industries and other interests such as testing laboratories and insurance companies. The workshop was held

in response to a recommendation of the National Forest Products Association.

General

32. Changes in Wood Harvesting and Utilization in the United States

Erickson, John R.
Medd. Nor. Inst. Skogforsk. 41(17): 251–265.

The future offers opportunities to expand markets for wood and to improve the productivity and quality of U.S. forests. This paper discusses resource availability, improvements in production of wood and wood fiber products, some implications for the future based on current research and development efforts, and the improvements made in wood utilization standards.

33. The New Forest Service International Forest Products Program: Experience to Date

Lindell, Gary R.
In: Lundgren, Allen L., ed. The management of large-scale forestry research programs and projects. Proceedings of a meeting of IUFRO subject group S6.06; 1989 April 17–19; Farnham, England. Gen. Tech. Rep. NE–130. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeast Forest Experiment Station; 1989: 177–183.

This paper describes the new Forest Service International Forest Products Program, which was initiated in 1988.

34. Integrating Social Sciences into Forest Resource Research

Marcin, Thomas C.
In: Discovering new knowledge about trees and forests. Proceedings: IUFRO Subject Group S6.09 meeting; 1985 August 19–23; Houghton, MI. Gen. Tech. Rep. NC–135. USDA Forest Serv., North Central Forest Experiment Station; 1989: 55–63.

Forestry and the value of forest resources are inexplicitly intertwined with the human habitat and social value systems. Traditional forestry studies and forest management have generally concentrated on narrow academic disciplines related to the growing and harvesting of trees. This paper discusses the need to broaden the base of scientific disciplines for forestry to include social sciences. The possibility of integrated systems analysis studies for forestry is also examined.

35. Moisture Transfer Through Materials and Systems in Buildings

TenWolde, Anton
In: Water vapor transmission through building materials and systems: Mechanisms and measurement, ASTM STP 1039, H.R. Trechsel and M. Bomberg, Eds., American Society for Testing and Materials, Philadelphia; 1989: 11–18.

This paper comments on the current discrepancies and the need for improved standard test methods and analytical tools for moisture control design.

36. Wood

Wegner, Theodore H.; Baker, Andrew J.; Bendtsen, B. Alan; Highley, Terry L.; Howard, James L.; LeVan, Susan L.; Miller, Regis B.; Minor, James L.; Pettersen, Roger C.; Rowell, Roger M.; Simpson, William T.; Youngquist, John A.; Zinkel, Duane F.
In: Mark-Bikales-Overberger-Menges Encyclopedia of Polymer Science and Engineering. Vol. 17, 2d ed. John Wiley & Sons, Inc.; 1989: 843–887.

Wood, a renewable resource, is the most abundant naturally occurring polymeric composite material. This paper provides summary information of wood in the following categories: structure, chemical composition, physical properties, wood pulp, chemicals from wood, modified wood, composites, fuel properties, and economic aspects.

37. 24. Research Methods

Zinkel, Duane F.
In: Zinkel, Duane F.; Russell, James, eds. Naval Stores—Production, Chemistry, Utilization. New York: Pulp Chemicals Association. Chapter 24; 1989. p. 803–845.

This chapter encompasses a range of research methods—from those that are simple but have not reached the regularity in use for formatting as formal standards to methods that are highly esoteric and require a high level of skill.

Microbial and Biochemical Technology

38. Continuous-Culture Responses of *Candida shehatae* to Shifts in Temperature and Aeration: Implications for Ethanol Inhibition

Alexander, M.A.; Chapman, T.W.; Jeffries, T.W.
Appl. Environ. Microbiol.; Sept. 1989: 2153–2154.

Temperature and aeration shifts were used to perturb steady-state continuous cultures to determine the effects of ethanol on xylose metabolism by *Candida shehatae*. The accumulation of ethanol exerted a delayed inhibitory effect on the specific rate of substrate utilization. A second effect was also observed in which the specific rate of xylitol production increased at the expense of the specific rate of ethanol production. Both effects were enhanced at higher temperature. Inhibitory effects also occurred in glucose metabolism.

Physical and Enzymatic Properties of Lignin Peroxidase Isoenzymes From *Phanerochaete chrysosporium*

Farrell, Roberta L.; Murtagh, Karen E.; Tien, Ming; Mozuch, Michael D.; Kirk, T. Kent
Enzyme Microb. Technol. 11: 322–328; 1989.

Available from Dr. R.L. Farrell, Repligen Sandoz Research Corporation, 128 Spring Street, Lexington, MA 02173. No charge.

Phanerochaete chrysosporium BKM–1767 secretes multiple lignin peroxidase isoenzymes when grown under nitrogen-limited conditions. This paper reports on the purification of these heme-containing peroxidases and their physical and catalytic characterization.

39. Adaptation of the Nelson–Somogyi Reducing-Sugar Assay to a Microassay Using Microtiter Plates

Green, Frederick III; Clausen, Carol A.; Highley, Terry L.
Anal. Biochem. 182: 197–199; 1989.

The Nelson–Somogyi assay for reducing sugars was adapted to microtiter plates. The primary advantages of this modified assay are (1) smaller sample and reagent volumes, (2) elimination of boiling and filtration steps, (3) automated measurement with a dual-wavelength scanning TLC densitometer, (4) increased range and reproducibility, and (5) automated colorimetric readings by reflectance rather than absorbance.

40. Roles for Biotechnology in Manufacture

Kirk, T. Kent; Eriksson, Karl-Erik
In: Roberts, Frank, ed. World Pulp & Paper Technology 1990—The International Review for the Pulp and Paper Industry; London: The Sterling Publishing Group PLC; 1989; 23–28.

This paper discusses potential roles for biotechnology in pulp and paper manufacture. These roles might be realized in primary pulp manufacture, pulp modification, recycled fiber treatment, waste treatment, byproduct conversions, and biosensor applications. Experience has shown that good communication between biotechnologists and industry technical staffs would speed evaluation of these roles.

41. Molecular Cloning and Sequences of Lignin Peroxidase Genes of *Phanerochaete chrysosporium*

Schalch, Heidi; Gaskell, Jill; Smith, Timothy L.; Cullen, Daniel
Mol. Cell. Biol.; June 1989: 2743–2747.

The genomic clones encoding lignin peroxidase isozyme H8 and two closely related genes were isolated from *Phanerochaete chrysosporium* BKM–1767, and their nucleotide sequences were determined. The positions and approximate lengths of introns were found to be highly conserved in all three clones. Analysis of homokaryotic derivatives indicated that the three clones are not alleles of the same gene(s).

Mycology

Nitrogenase Activity Associated With Decayed Wood of Living Northern Idaho Conifers

Harvey, A.E.; Larsen, M.J.; Jurgensen, M.F.; Jones, E.A.
Mycologia 81(5): 765–771; 1989.

Available from Alan E. Harvey, Intermountain Research Station, Forestry Sciences Laboratory, Forest Service, U.S. Department of Agriculture, Moscow, ID 83845. No charge.

Nitrogen fixation, as determined by the acetylene reduction technique, was demonstrated in decay columns of western larch and western white pine caused by *Phellinus pini*, western redcedar caused by *Postia sericeomollis* and western hemlock and grand fir caused by *Echinodontium tinctorium*. Nitrogenase activity varied with tree species, fungal pathogen, wood decay stage, and seasonal moisture-temperature regimes within decaying stems. Nitrogen fixation potential in the productive forest ecosystems of northern Idaho was calculated between 0.06 kg/ha per year and 4.91 kg/ha per year and was primarily dependent on volume of decay in live standing trees on site.

Processing of Wood Products

42. Kiln Drying 4/4 American Elm and Sweetgum Lumber With a Combination of Conventional-Temperature and High-Temperature Schedules

Boone, R. Sidney
USDA Forest Serv. Res. Pap. FPL–RP–491; 1989. 15 p.

A group of studies was started at the Forest Products Laboratory to better understand the responses of three species (red maple, American elm, and sweetgum) to increasing the dry-bulb temperature to 230°F at various levels of moisture content. This study presents the results of the studies on 4/4 American elm and sweetgum lumber.

43. Heat and Moisture Transfer in Wood During Drying

Liu, J.Y.; Cheng, S.
In: Perkins, R.W., ed. Mechanics of cellulosic and polymeric materials: Proceedings, 3d Joint ASCE/ASME Mechanics conference; 1989 July 9–12; San Diego, CA. New York: The American Society of Mechanical Engineers; 1989: 79–85.

This paper presents an analytical method to solve the Luikov system of linear partial differential equations subject to specified initial and boundary conditions. Luikov equations are the governing equations in analyzing heat and mass diffusion problems for porous materials. The method of solution presented is illustrated by considering the transient distributions of temperature and moisture in a slab of wood during drying. Numerical results are obtained and compared with experimental data for spruce specimens. The method should have a general application to problems of heat and mass transfer in capillary porous materials.

44. Processing and Products Considerations Critical in Utilizing Second-Growth Ponderosa Pine

Maeglin, Robert R.
In: Baumgartner, David M.; Lotan, James E., eds. Ponderosa pine—The species and its management: Proceedings of symposium; 1987 September 29–October 1; Spokane, WA. Pullman, WA: Washington State University; 1988: 19–24.

This paper discusses the effects of juvenile wood, compression wood, and longitudinal growth stresses on the processing of second-growth ponderosa pine, and presents ways to circumvent or eliminate warp in processing.

45. Plywood Manufacturing Cost Trends, Excluding Wood, in Western U.S. Mills: 1975–1988

Spelter, Henry
USDA Forest Serv. Gen. Tech. Rep. FPL–GTR–64; 1989. 12 p.

This study was undertaken to obtain relatively current data on manufacturing costs and to determine the extent to which costs may have changed since 1983 as a result of new technologies to reduce costs and improve productivity. The data base for this study was the 1988 Forest Service mill survey.

Pulp, Paper, and Packaging

46. Method for Measuring Mechanosorptive Properties

Gunderson, D.E.
In: Perkins, R.W., ed. Mechanics of cellulosic and polymeric materials: Proceedings, 3d Joint ASCE/ASME Mechanics conference; 1989 July 9–12; San Diego. New York: The American Society of Mechanical Engineers; 1989: 157–165.

This report describes a new method developed for measuring the mechanosorptive properties of cellulosic materials. In this method, sorbed moisture is continuously measured while the stress applied to the specimen is varied. Environmental temperature and humidity are held constant, but the method can be modified for use in cyclic humidity environments. The results of tests are described and used to verify the method, and then these results are compared with the Barkas theory of mechanosorption. The method is applicable to paper, solid wood, and a variety of fabrics and films made from cellulosic and composite materials.

47. Economic Assessment of Biomechanical Pulping

Harpole, George B.; Leatham, Gary F.; Myers, Gary C.
In: Proceedings of the international mechanical pulping conference 1989—Mechanical pulp—Responding to the end product demands; 1989 June 6–8; Helsinki. Helsinki: Multiprint: 398–408. Vol. 2.

This paper illustrates the economic value of the energy saving potential that might be realized by biomechanical pulping technology. To accomplish this, the estimated cost savings from reduced fiberizing and refining power was capitalized to indicate how much facilities investment and operating costs could be increased without increasing product costs. To obtain these estimates, conventional discounted cash flow techniques were used to analyze the investment and operating cash flows simulating a thermomechanical pulp mill producing newsprint.

48. Analysis of Future High Levels of Wastepaper Use in Regional Pulpwood Markets in the United States

Howard, James L.; Durbak, Irene; Ince, Peter J.; Lange, William J.
In: Potter, Richard H., ed. Restructuring to cope with changing times: Proceedings of the 1989 Southern forest economics workshop; 1989 March 1–3; San Antonio, TX. Huntsville, TX: Champion International; 1989: 196–205.

A North American pulp and paper model, known as the Pulpwood Model, projects regional pulpwood and fiber consumption in the U.S. pulp and paper industry over five decades, starting in 1986. The projections are needed to consider the impacts of possible changes in technology on pulpwood and fiber requirements. This paper discusses a High Recycled Fiber scenario using the Pulpwood Model to evaluate the impacts on timber supply and pulpwood prices of current legislative initiatives. This scenario was aimed at achieving higher levels of recovery of waste material deposited in landfill sites in the United States. The objective of this paper is to discuss results and projections using the Pulpwood Model and the High Recycled Fiber scenario.

49. Fungal Resistance of Pine Particle Boards Made From Various Types of Acetylated Chips

Nilsson, Thomas; Rowell, Roger M.
Holzforschung. 42: 123–126; 1988.

This research was twofold: (1) to determine if the standard fungus cellar test used for solid wood blocks could be used directly on particle boards made with melamine-urea-formaldehyde adhesive, without the adhesive having a toxic effect on the soil micro-organisms and (2) to then use the fungus cellar test to evaluate the rot resistance of particle boards made from different types of acetylated chips.

50. Moisture Sorption Properties of Acetylated Lignocellulosic Fibers

Rowell, Roger M.; Rowell, Jeffrey S.
In: Schuerch, Conrad, ed. Cellulose and wood—Chemistry and technology: Proceedings of the 10th cellulose conference; 1988 May 29–June 2; Syracuse, NY. New York: John Wiley & Sons, Inc.; 1989: 343–355.

This paper reports on acetylation of spruce chips followed by fiberization and shows that new moisture sorption sites are created during fiberization. Direct acetylation of wood fiber is the most efficient means of reducing equilibrium moisture content.

51. Biomechanical Pulping of Aspen Chips by *Phanerochaete chrysosporium*: Fungal Growth Pattern and Effects on Wood Cell Walls

Sachs, Irving B.; Leatham, Gary F.; Myers, Gary C.
Wood and Fiber Sci. 21(4): 331–342.

Evaluation of the potential of biopulping requires a better understanding of its physical and chemical basis. This paper reports on an investigation of the fungal treatment used on wood chips prior to mechanical pulping in a bench-scale biomechanical pulping process currently under study. Scanning electron microscopy was used to observe fungal growth and the degradation of nutrient-supplemented aspen chips after a 3-week treatment with the white-rot basidiomycete *Phanerochaete chrysosporium* strain BKM–F–1767.

52. Influence of Cations and Borate on the Alkaline Extraction of Xylan and Glucomannan From Pine Pulps

Scott, Ralph W.
J. Appl. Polym. Sci. 38: 907–914; 1989.

This report contains measurements of the effects of three cations and borate on alkali extractions. The results supplement previous reports that KOH is much less effective than NaOH in glucomannan extraction and that borate additions to the alkali increase glucomannan extraction. Also, the results suggest modes of hemicellulose distribution. Oxygen pulps were used because of their large glucomannan content. A kraft pulp provided a chemical pulp containing resorbed xylan. Holocellulose was used for comparison because its hemicellulose is the least disturbed and, indeed, is almost intact.

Nonlinear Elastic Constitutive Relations for Cellulosic Materials

Suhling, J.C.; Johnson, M.W.; Rowlands, R.E.; Gunderson, D.E.
In: Perkins, R.W., ed. Mechanics of cellulosic and polymeric materials: Proceedings, 3d Joint ASCE/ASME Mechanics conference; 1989 July 9–12; San Diego. New York: The American Society of Mechanical Engineers; 1989: 1–15.

Available from J. C. Suhling, Department of Mechanical Engineering, Auburn University, Auburn, AL 36849. No charge.

In this work, the mechanical behavior of paperboard under the action of uniaxial and biaxial states of loading is investigated analytically and experimentally. Analytical work concentrated on the formulation of a set of new nonlinear elastic constitutive relations for orthotropic media based upon a hyperelastic material model. An assumed form for the strain energy density function incorporating a single effective strain variable is proposed. The theory predicts constant Poisson's ratios but allows for nonlinear uniaxial stress-strain response. Extensive uniaxial and pure shear testing are performed on paperboard to measure the material constants present in the new theory and to determine the functional form of the strain energy density function. The results of additional paperboard biaxial experiments are utilized to evaluate the predictive capabilities of the constitutive model.

Timber Requirements and Economics

53. Risk Analysis Proposed for Evaluating Impacts of Scientific Research on Economic Decision Making

Ince, Peter J.
In: Discovering new knowledge about trees and forests: Proceedings, IUFRO Subject Group S6.09 meeting; 1985 August 19–23 Houghton, MI. Gen. Tech. Rep. NC–135. USDA Forest Serv., North Central Forest Experiment Station; 1989: 107–112.

This paper is not concerned with how to evaluate scientific research in general but simply with how to evaluate current and foreseeable impacts of scientific research on economic decision-making criteria. According to conventional economic theory, economic decision making is the vehicle through which economic impacts of research are thought to be arranged.

54. Timber Utilization Trends and Opportunities for Tribal Timber

Ince, Peter J.
In: Vision of an Indian forest—Total resource management: Proceedings of 13th annual national Indian timber symposium; 1989 March 28–30; Phoenix, AZ. [Vancouver, WA]: Intertribal Timber Council; 1989: 295–320.

This report presents some current views on changing wood product technology, likely effects on regional markets for timber, and some important trends that are taking place in the forest product sector. Also some market opportunities or ideas for wood products that might be developed as a small business or tribal enterprise are discussed.

Tropical Wood Utilization

55. Grouping Tropical Wood Species for Kiln Drying

Simpson, William T.; Baah, Charlie K.
USDA Forest Serv. Res. Note FPL–RN–0256; 1989: 14 p.

This report describes a method to group species according to similar estimated drying times so that they could be dried in the same kiln charge and emerge from the kiln at the same time within set limits of final moisture content.

Wood Bonding Systems

56. Weatherability of Xylitol-Modified Phenolic-Bonded Flakeboard

Jokerst, Ronald W.
Forest Prod. J. 39(10): 35–38; 1989.

This research was undertaken to determine if the water repellency of the xylitol-modified phenolic (XMP) adhesive has any lasting effect and to obtain additional information on its durability. Selected mechanical and physical properties of flakeboards bonded with XMP adhesive were compared to those bonded with a commercial phenolic adhesive system after 1 year of unprotected exterior exposure.

57. ^{1}H- and ^{13}-C-NMR Studies on Phenol-Formaldehyde Prepolymers for Tannin-Based Adhesives

McGraw, Gerald W.; Landucci, Lawrence L.; Ohara, Seija; Hemingway, Richard W.
J. Wood Chem. Technol. 9(2): 201–217; 1989.

The number average structure and the molecular weight distribution of phenol-formaldehyde prepolymers for use in synthesis of tannin-based adhesive resins were determined with ^{1}H- and ^{13}C-NMR spectroscopy and gel permeation chromatography of acetylated resins. These methods were used to determine differences in phenol-formaldehyde prepolymers prepared under different reaction conditions.

Quantitative ^{13}C-NMR techniques provided a detailed analysis of the structure of a phenol-formaldehyde prepolymer.

58. Advances in Methods to Reduce Formaldehyde Emission

Myers, George E.
In: Hamel, Margaret P., ed. Composite board products for furniture and cabinets—Innovations in manufacture and utilization: Proceedings 47357; 1986 November 11–13; Greensboro, NC. Madison, WI: Forest Products Research Society; 1989: 58–64.

During the past several years, significant improvements have been made in reducing formaldehyde emission from urea-formaldehyde-bonded wood panels. These improvements are the consequence of technological advances in resin formulations and in panel processing. This paper summarizes these major technological advances and their effectiveness. Also presented is an overview of the U.S. formaldehyde regulatory situation and some data demonstrating that an overall emission reduction has indeed occurred in the United States.

59. New Curing System of Urea-Formaldehyde Resins With Polyhydrazides I. Curing With Dihydrazide Compounds

Tomita, Bunichiro; Osawa, Hideaki; Hse, Chung Y.; Myers, George E.
Mokuzai Gakkaishi. 35(5): 455–459; 1989.

This paper reports on a nonconventional curing system that was developed using a simple mixing of urea-formaldehyde (UF) resins with polyfunctional hydrazide compounds under neutral condition. Several kinds of low molecular-weight dihydrazide compounds were investigated as hardeners of the UF resins.

60. New Curing System of Urea-Formaldehyde Resins With Polyhydrazides II. Curing With Poly(methacryloyl Hydrazide)

Miyake, Katsumasa; Tomita, Bunichiro; Hse, Chung Y.; Myers, George E.
Mokuzai Gakkaishi. 35(8): 736–741; 1989.

This is the second in a series of papers on a new curing system for urea-formaldehyde (UF) resins being investigated using poly(methacryloyl hydrazide) as the curing reagent.

61. New Curing System of Urea-Formaldehyde Resins With Polyhydrazides III. Curing Reaction Mechanism

Miyake, Katsumasa; Tomita, Bunichiro; Hse, Chung Y.; Myers, George E.
Mokuzai Gakkaishi. 35(8): 742–747; 1989.

A new curing system for urea-formaldehyde (UF) resins has been developed using hydrazide polymer and dihydrazide compounds as curing agents as reported in the previous papers of this series. The reaction mechanism of this system was investigated with the carbon 13 nuclear magnetic resonance technique and torsional braid analysis.

62. Adhesive Joint Fracture Behavior During Setting and Aging

River, B.H.; Scott, C.T.; Koutsky, J.A.
Forest Prod. J. 39(11/12): 23–28; 1989.

This study focuses on the changes in the fracture toughness of a room-temperature-set urea-formaldehyde resin adhesive during setting and aging. Toughness was measured in cleavage using a contoured double-cantilever beam specimen formed of a wood laminate and contoured aluminum beams. Patterns of changing fracture toughness and crack-growth behavior during setting and aging provide insight into the chemical processes and physical changes underlying setting and aging.

Special Item

Wood-Frame House Construction

Sherwood, Gerald E.; Stroh, Robert C.
Agric. Handb. 73. U.S. Department of Agriculture, Washington, DC. 260 p..

Available from Superintendent of Documents, Dept. 36–GT, U.S. Government Printing Office, Washington, DC 20402–9325. Phone: (202)783–3238. Stock No. 001–000–04547–4. Cost: $13.00.

This updated handbook presents sound principles for wood-frame house construction and suggestions for selecting suitable materials to assist in the construction of a good house. It can be used as a working guide to modern construction practice and techniques, as a textbook, or as a standard to judge the quality of house construction.

The organization of the book reflects the general progression of activity in building a wood-frame house, from initial conception to completed structure. Chapter 1 describes matters that should be considered or dealt with before beginning construction. Chapters 2 to 4 describe steps in laying the groundwork, framing and closing in, and completing the shell, which are usually taken one step after another in the order presented. Chapters 5 to 7 describe later tasks that can often be done in some order other than presented. Chapter 8 discusses special topics often associated with wood-frame construction. An annotated list of suggestions for additional reading and a glossary are provided at the end of the book.

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